A PLEA FOR OUT-OF-DOOR ZOÖLOGY

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A practical knowledge of field zoölogy was a necessity for savage man. We may even go beyond this—it was necessary for the prehuman ancestors of man. Neither could have existed without knowing the habits and haunts of friends and foes.

With the beginning of city life the necessity for this knowledge ceased among a large part of the human race. At the present time a close acquaintance with wild forms of animate nature is limited to the naturalist, professional or amateur, the sportsman, and in some degree, the farmer.

Among professional zoölogists, knowledge of living animals in their native haunts is often slight. Indeed, there is a group of zoölogists who deride the study of higher forms of animals under natural conditions as "vague," "unscientific," and "worthless." It is undeniable that such studies are often vague and unsatisfactory, for they are often extremely difficult. Worthless they cannot be if they are extensive and made with care and understanding. For the final test of every biological theory is, "Will it work when applied to the living creature?"

Perhaps I should state that my plea is intended for the student rather than the teacher. The out-of-doors would be the ideal place to teach zoölogy under ideal conditions. In a school where the subject is sandwiched in between the rest of the curriculum, where classes are large, and where there is only a limited daily period in which it can be taught, the teacher must weigh the discipline of the laboratory against the interest of the field; and the former will usually preponderate.

I also desire that nothing that I may say here shall be understood as a disparagement of the microscopist, the experimentalist or the systematist whose work is chiefly indoors. They have contributed much to our understanding of the great general prob-

lems of heredity, evolution, and development, as well as to preventive medicine and various other intensely practical questions.

To accomplish anything in the way of microscopical and experimental research it is necessary to have microscopes, reagents, and various other forms of expensive laboratory apparatus, as well as a thorough knowledge of technique, and sufficient time for long and close application. Systematic research, at the present time, requires access to large collections which must be well arranged and well housed. Nor can much be done in the way of systematic study without a very considerable library containing rare and expensive books.

The equipment for the study of zoölogy out of doors is far less expensive. This does not mean that books are unnecessary or that a small amount of knowledge will suffice. In no branch of science is there more need for keener perceptions, better judgment, and wider scope of information than in the study of living animals. But the monetary outlay needed for such study is very small, and the opportunity is open to everyone who has frequent access to a bit of woodland, pond, lake, or stream. And if he fails to accomplish much in the way of research he will at least have healthful recreation and a great deal of genuine pleasure.

It is not the purpose of this paper to enter into the technique of collecting specimens for museum purposes, although this has been, and still is, one of the most important lines of field work in zoölogy. Information on methods of collecting and preserving can be obtained from the National Museum, the Department of Agriculture, or in various books that are on the market. Neither do I enter a plea for studies that shall be made exclusively in the open, unchecked by observations in the laboratory or by familiarity with the work of others along the same line.

The study of living animals may be carried on along three general lines: the development and growth of the individual (ontogeny); habits, instincts, and senses (psychology); relation to the environment (ecology). It is not often desirable to make a sharp distinction between these different lines of investigation when we are making a study of living species of the fauna of a given area, and no such distinction will be made here.

The life of any animal might be considered under the following heads:

The span of life: Development, including changes in appearance with growth; age attained under normal conditions; condition of life during old age.

Breeding habits: Age at which the reproductive functions became active; secondary sexual characters; number of offspring; season when offspring are born; period of gestation; care of young by parents; number of mates during the lifetime of the animal; site of home; character of nest if any is made.

Food: Kinds preferred; kinds available that are sometimes eaten; quantity necessary; quantity available in a given area.

General activities: Does the animal hibernate? If so, how long? Is hibernation affected by the weather? Range of the individual in one day, and during its lifetime.

Mental traits: Cunning; adaptability; teachability.

Senses: General development; senses used in procuring food, in recognizing mates, in finding the way home.

Enemies: Kinds; number.

Relation to physical environment: Effect of weather; of severe droughts; floods; severe cold; unusual heat.

The above list is merely a suggestive outline; yet all of the topics included in it have not been carefully studied for a single wild animal, and there is hardly one of these points that has been carefully studied for some of our commonest species.

It would not be necessary to discuss in detail the methods of studying each of these problems, even if I were competent to do so, but it may be worth while to suggest a few problems more specifically and indicate some methods of investigation in this field.

Much can be learned about an animal by keeping it in captivity under conditions that are as nearly as possible like its natural surroundings. Even under the best of artificial conditions it is necessary to make some allowance for abnormal changes in behavior due to changes in environment, and every study of a captive animal should be checked as far as possible by observation of its unconfined relatives.

If a captive animal has room for exercise and becomes sufficiently accustomed to its surroundings to eat well, it is reasonable to assume that its appetite will remain normal. It is easily possible to measure its food and to determine its food preferences by actual

tests. Captive animals will also furnish information in regard to the breeding habits, family life, and longevity of their race; but these things are apt to be more affected by the abnormal conditions of captivity than is the animal's appetite.

For the study of mental traits and sense development of animals it is necessary to become familiar with some of the recent literature of comparative psychology and animal behavior before drawing conclusions; but it is also very desirable that the laboratory methods employed by students of animal psychology should be supplemented by close observation of the animals in their natural environment. Anecdotes relating the wonderful intelligence or fidelity of an animal whose history is unknown are no longer considered scientific literature. In the field of animal psychology there is also special need for the careful study of the development of the senses and mental life, and of the awakening of hereditary instincts in young animals.

An excellent and little-appreciated means of getting information concerning the general activities of some animals is the study of their tracks in the snow. By seizing upon a favorable opportunity, when snow lies fresh and soft and where it is little disturbed by animals or men, one can follow the tracks of an animal, say a mink or a weasel, and learn its nightly range, where it has turned aside from its path and why, what it has eaten, and whether it has traveled singly or in company. This may be a muscle-tiring task, for most carnivorous animals range far in a night. The snow records of wood mice and shrews are also good indexes of their activity and of their enemies. Tracks of rabbits help one to learn what the animals have been eating, but, on account of their great number and erratic character, have less value than those of some other animals. Even birds leave tracks in the snow that show their favorite haunts and indicate the source of their winter food.

A most interesting study, although not a new one, is the ecology of some group of animals within a limited area of varied character. Suppose it is birds we are studying and we have a convenient area of, say, a square mile, marked off by roads or streams or some other definite boundaries. The area, to be most attractive, should contain a house and its grounds, cultivated fields, meadow, brushy

pasture, wood lot, and swamp, though all of these are not necessary. What birds regularly nest in each division? Is a species restricted to one division in its nesting site, and, if it is at all restricted, is this because of enemies, lack of material for building nest, suitable spot to place the nest, or some other reason? Does it feed in the same area in which it nests, and on what does it feed? To what extent does it wander into the tracts which it does not regularly inhabit? What is the relative abundance of birds in each tract? As an answer to the last question a guess is worse than useless, and the only way to answer it is to take a census of the entire area on several different days, checking up the results and making such allowance for error as experience seems to dictate.

A similar study could be made of the small mammals, using snow records, trapping, and frequent observation as the means of getting data.

Batrachians are also of great interest when studied in relation to their environment. How many frogs and toads frequent a given pond during the breeding season? Do they prefer one body of water to another equally accessible, and if so, why? What becomes of them after the breeding season? What are the details of growth and the transformation changes accompanying growth? These are a few of the many problems awaiting study among the batrachians.

I have not alluded to reptiles and fishes, nor to any of the invertebrates, not because they do not offer many problems of great biological interest, but chiefly because they are less familiar to me and there is not space to discuss all.

The last century has been rich in biological discoveries, but as yet we have learned only a line here and there in the great book of life. The microscope, the scalpel, and the museum can teach us much of what is left, but there are many pages that can be read with pleasure and profit in the open.